REMARKS

Applicants have amended claims 10-17 and 19-21 to clarify that the subject matter of the invention regards a pouring shroud, and that said pouring shroud is suitable for use prior to preheating. Claim 18 is cancelled and its subject matter is incorporated into claim 1. Applicants respectfully request reconsideration and allowance of claims 10-17 and 19-21.

Rejections under §103

The Examiner rejected all pending claims (10-17 and 19-21) under 35 U.S.C. §103 (a) as being unpatentable over U.S. Patent No. 5,094,692 to Dumazeau ("Dumazeau") in light of U.S. Patent No. 6,380,114 to Brandy ("Brandy"). The Examiner replies to Applicants' comments in the Response of February 8, 2006 by stating that "the features upon which applicant relies (i.e. thermal shock of a non-preheated pouring shroud) are not recited in the rejected claims.

Applicants have amended the claims to require that the pouring shroud is suitable for use prior to being preheated. Applicants respectfully request that the Examiner reconsider the substance of the Response of February 8, 2006 (reproduced below) in light of the claim amendments.

The Examiner states that Dumazeau "teaches the claimed refractory casting element (pouring shroud) for pouring molten metal . . . comprising a base body made of a refractory material such as graphitized alumina coated by gas impermeable coating layer having thickness between 1 and 2 mm and comprising ceramic refractory such as alumina and silica."

The Examiner further states that Brandy "teaches the use of insulating coating material including 5-40 wt % insulating hollow microspheres of silica and alumina for the purpose of reducing weight and improving thermal insulation."

The Examiner indicates that it would have been obvious to one of ordinary skill in the art to modify the invention of Dumazeau by providing the insulating coating of Brandy.

Applicants respectfully traverse the examiner's rejections for the following reasons. Dumazeau relates to refractory articles for molten metal applications comprising a gas impermeable coating. During the casting of molten metal, air aspiration has a certain number of negative effects (refer to col. 1, lines 24-41 of Dumazeau) (oxidation of the molten metal resulting in the so-called alumina build-up, degradation of the steel quality through the formation of inclusions of oxide and gas bubbles entrained in the stream, increase of nitrogen pick-up). The object of Dumazeau is thus an improved gas impermeable coating that remedies the problem of these negative effects of air aspiration (col. 1, lines 55 to 58). The coating of Dumazeau is similar to a glaze and is used as such.

The essential parameter of Dumazeau is the permeability of the coating, which has to be as low as possible in order to avoid air aspiration through the material. Dumazeau does not relate to, nor discusses the insulation of refractory articles. In particular, Dumazeau does not address the problem of thermal shock of a non-preheated pouring shroud at the beginning of the casting (i.e. a "cold start"). The problem faced with the commonly used internal oxidation layers of ladle shrouds (i.e. "pouring shrouds") is not mentioned and therefore the possible replacement of this oxidized layer by another material or method is not suggested.

Brandy relates to an insulating refractory material for molten metal applications. A large number of applications are considered, for example, the use of the material to manufacture

insulating sleeves or as a coating to reduce heat loss of refractory articles. Brandy discloses a coating comprising notably 20-80% by weight of a ceramic matrix and 5-40% by weight of insulating hollow microspheres. The ceramic matrix confers to the coating its refractory aspect (high melting point). The matrix may consist of vitreous silica or oxide such as alumina or magnesia. The matrix is not used for preventing the shroud from the attack of inclusions as stated by the Examiner (end of page 3 of office action). Insulating microspheres (also called light-weight microspheres) are hollow and confer to the coating its excellent insulating properties.

The objective of Brandy is the replacement of the insulating coatings containing fibers. Such fiber sheets are well known to persons skilled in the art. The sheets are wrapped around and glued on the external surface of the shrouds. The fibers are toxic for the operator and besides are no longer allowed by new health and safety regulations. Brandy relates to a new generation of insulating coating called "fiber free." Insulating coatings are normally light, highly porous and contain a lot of air entrapped therein so as to confer to the coating good insulating properties.

However, Brandy does not discuss the permeability or impermeability of the coating. The problem of air aspiration in molten metal casting operations is not mentioned either. The essential parameter of Brandy is the composition of the insulating material and its resulting insulating properties.

It should be noted that the development of an insulating coating is a completely different approach for the development of an impermeable coating, one is highly porous and contains air, the other has a low porosity (low permeability is usually directly linked to low porosity and vice versa) and air is not desired. Dumazeau relates to impermeable coating and Brandy to insulating

material. There is *a priori* no reason to combine these two documents unless suggested within of the two documents (which is not the case).

In contrast, the present application relates to refractory articles for molten metal applications, in particular a ladle shroud, comprising an insulating coating on the internal surface. Ladle pouring shrouds are "cold start" products (not preheated before use) and thus very sensitive to thermal shock. Standard pouring shrouds comprise an internal oxidized layer. The layer acts as a barrier so as to better resist thermal shock at the beginning of the casting (paragraph [006]).

This method has nevertheless some drawbacks. The thickness of the oxidized layer is difficult to control and the insulating properties of the "barrier" are not homogeneous. Furthermore, having lost its binder (carbon bond is oxidized), the layer is progressively washed away at the molten metal contact weakening the entire shroud. The wall thickness of the shroud, after a few minutes of casting, can be as low as 15 mm and the resulting mechanical resistance becomes insufficient (notably to absorb the shocks due to the slide gate movements).

The object of the present invention is a pouring shroud having an increased thermal shock resistance, which does not have the above-mentioned drawbacks. The shroud of the invention should furthermore sustain a "cold start" application while the other critical properties of the shroud, namely, the mechanical resistance and the impermeability to gas <u>during</u> casting are retained. The above objective is achieved by the coating element defined in claim 1.

As noted above, the impermeable layer of Dumazeau (glaze type) does not include insulating hollow microspheres. The object of the present invention is thus novel with respect to Dumazeau.

The insulating coating of Brandy is not located on the inner surface of a pouring shroud but externally to reduce heat loss. The object of present invention is thus novel with respect to Brandy. Another difference is the transformation of the coating into an impermeable layer during casting.

Applicants respectfully suggest that the most relevant reference is Brandy, which relates to insulating materials and a pouring shroud covered with such a coating. However, the pouring shroud of the present application is distinguished over the shroud of Brandy by the fact that the coating is applied on the internal surface and by the fact that the coating forms an impermeable to gas layer at casting temperature.

Those differences permit the use of the pouring shroud without preheating it (cold), with the shroud being capable to sustain the thermal shock at the beginning of the casting. Furthermore, the gas impermeable layer formed later on protects molten metal against air aspiration.

In Brandy, the insulating coating is not in contact with molten metal except for the immersed part of the shroud. Obviously, there is no insulation nor air aspiration problem in the immersed part, the shroud being surrounded by molten metal at high temperature.

The problem of a cold start ladle shroud is not discussed in Brandy, there is no suggestion that the coating could be applied internally for this particular application and there is no hint that the layer would provide an advantage by its transformation into an impermeable gas layer.

Knowing the teaching of Brandy, the skilled person who wants to provide a shroud with increased thermal shock resistance suitable for cold start application has, at first, no reason to consult Dumazeau. Indeed, the problem of impermeability and air aspiration is not the object of the present application, the formation of an impermeable layer is just an additional advantage, it

is not the first objective. In case the skilled person would consult Dumazeau anyway, there is no indication that the layer should contain insulating microspheres and should be applied on the internal surface of the shroud, the layer of Dumazeau being applied (as a glaze) on the external surface.

Regardless of which reference is considered the primary reference, there is no motivation or suggestion, within the references themselves, to combine the teachings of Dumazeau and Brandy. Dumazeau is solely concerned with preventing air aspiration, not thermal properties. Thus, one skilled in the art, reading Dumazeau, would have no motivation to combine its teachings with those of Brandy. Furthermore, the neither the teachings of Dumazeau nor the teachings of Brandy are directed towards an article that is suitable for use prior to preheating. As such, there would be no motivation to combine the references in an attempt to produce a pouring shroud suitable for use prior to preheating. Such a motivation or suggestion is required for a *prima facie* case of obviousness. Therefore, applicants respectfully submit that such a *prima facie* case has not been made by the Examiner.

In light of the above, Applicants respectfully submit that claims 10-17 and 19-21 are patentable over the prior art. Early and favorable action is earnestly solicited.

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Respectfully submitted,

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Marked up Version of the Claims

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10. (Amended) [An element] A pouring shroud for the casting of a liquid metal, comprising a base body made from a refractory material, said body comprising an outer surface and an inner surface defining a pouring channel for the casting of the liquid metal, wherein at least a part of the element inner surface is coated with an insulating coating comprising insulating hollow microspheres, preferably in an amount comprised between 5 and 40 weight % and forming, at the metal liquid contact, a gas impermeable layer, and wherein the pouring shroud is suitable for use prior to being preheated.
11. (Twice Amended) A [casting element]pouring shroud according to claim 10, wherein the coating comprises 20 to 80 weight % of a ceramic matrix.
12. (Amended) A [casting element]pouring shroud according to claim 11, wherein the ceramic matrix comprises silica or alumina.
13. (Twice Amended) A [casting element]pouring shroud according to claim 12, wherein the ceramic matrix comprises vitreous grains.

14. (Amended) A [casting element]pouring shroud according to claim 13, wherein the vitreous grains comprise atomized silica.

15. (Twice Amended) A [casting element]pouring shroud according to claim 10, wherein the thickness of the coating is between 1 and 10 mm.

16. (Twice Amended) A [casting element]pouring shroud according to claim 10, wherein the impermeable layer and the refractory material are interpenetrated.

17. (Twice Amended) A [casting element]pouring shroud according to claim 10, wherein the base body is constituted from a carbon bonded material.

18. CANCELLED

19. (Twice Amended) A [casting element]pouring shroud according to claim 10, wherein at least a part of the external surface is coated with an insulating coating comprising insulating microspheres.

20. (Amended) A [casting element]pouring shroud according to claim 19, wherein the insulating microspheres comprise between 5 and 40 weight % of the insulating coating.

21. (Amended) A method of coating a [casting element]pouring shroud comprising a base body made from a refractory material, said body comprising an outer surface and an inner surface defining a pouring channel for the casting of the liquid metal, comprising the steps of preparing a slip comprising insulating hollow microspheres, drying the slip at room temperature, preferably for at least two hours, and forming a gas impermeable layer from the dried slip by contacting the dried slip with liquid metal.